

ECONOMIC FEASIBILITY OF A SMALL ON-THE-FARM MILK PROCESSING PLANT



UNITED STATES
DEPARTMENT OF
AGRICULTURE

MARKETING
RESEARCH REPORT
NUMBER 1087

PREPARED BY
SCIENCE AND
EDUCATION
ADMINISTRATION

PREFACE

This report provides information for dairy farmers considering the construction of on-the-farm milk processing plants built in conjunction with production operations. Layouts of a new milk processing plant are included, along with cost data showing the potential benefits to be achieved by building such facilities.

Appreciation is extended to the dairy firm whose facilities and operations provided the basic data used in developing the information in this report.

This study was conducted under the general supervision of T. F. Webb, Chief, Animal Products Marketing Laboratory, Agricultural Research Service.

On January 24, 1978, four USDA agencies—Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Extension Service (ES), and the National Agricultural Library (NAL)—merged to become a new organization, the Science and Education Administration (SEA), U.S. Department of Agriculture.

This publication was prepared by the Science and Education Administration's Federal Research staff, which was formerly the Agricultural Research Service.

CONTENTS

	Page
Summary	1
Introduction	1
Description of the new milk processing plant	2
Existing milkhouse.....	5
Processing and filling room.....	5
Storage room.....	6
Cooler.....	7
Equipment room.....	7
Locker and restroom	8
Office and laboratory	8
Cost-benefit analysis	8
Initial investment cost.....	8
Annual ownership and operating cost.....	9
Potential benefits.....	10
Conclusions	11

ECONOMIC FEASIBILITY OF A SMALL ON-THE-FARM MILK PROCESSING PLANT

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SUMMARY

The construction and operation of on-the-farm dairy processing plants is one alternative available to dairy farmers for increasing the returns on their investment. However, to be successful the plants must be properly planned and have an adequate supply of raw milk and a dependable market for the finished products.

This report provides layouts and cost data for dairy farmers considering the construction and operation of on-the-farm processing plants. It includes a detailed description of a new milk processing plant built in conjunction with an existing production operation. The plant is designed to process and handle the annual raw milk production of a 200-cow herd (338,520 gal) and a small volume of fruit drinks (26,000 gal). Layouts show the arrangement of the individual plant areas and equipment and the other facilities on a building site. A cost-benefit analysis of the new plant is provided, and a determination is made concerning the minimum production required for a profitable operation.

The estimated total initial investment for facilities and equipment is \$129,295. The facilities cost of \$57,995 includes the construction of the plant, the water well, the sewage disposal lagoon, and a

septic tank system. The equipment cost of \$71,300 includes the purchase and installation of both new and used equipment.

The estimated total annual ownership and operating cost in the new plant is \$126,689. It includes all the items normally associated with the operation of a small processing plant, except distribution, which is not required where finished products are picked up by the customers at the plant.

With an annual ownership and operating cost of \$126,689 and a raw milk value of \$259,168, the total annual operating cost is \$385,857. The total sales of \$415,582 minus the total operating cost provides an annual profit of \$29,725. By applying this profit to the initial investment for facilities and equipment of \$129,295, the amortization time including interest at 8 percent is 5.57 years.

A minimum production of 220,000 gallons annually is required to make on-the-farm processing of raw milk a profitable dairy enterprise. The estimated total annual operating cost for processing this volume is \$253,879, which includes an annual ownership and operating cost of \$85,491 and a raw milk value of \$168,388. The total annual sales are \$253,992, slightly more than the total annual operating cost.

INTRODUCTION

Dairy farmers are constantly searching for new ways to increase the returns on their investment. The Federal market order prices paid for grade "A" milk have increased considerably since the 1960's, but so has the cost of production. The major factors contributing to increased production cost are replacement stock, feed, pastureland,

labor, and equipment. To compensate for these and other cost increases, many of the larger milk producers have built on-the-farm dairy processing plants to handle their own production. The plants vary in size and type from those designed to process and handle only fluid milk to those that also process such products as ice cream and cottage cheese. Many have retail dairy stores connected to the plants, whereas others also have

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these stores in consumer areas for marketing their products. However, most of the plants market their products by mutual agreements or contracts through small volume independent retail stores.

On-the-farm dairy processing plants have met with varying degrees of success. Many have failed to survive because of an inadequate and fluctuating supply of raw milk and the lack of a dependable market for finished products. Some have been unsuccessful because of poor management and improperly trained personnel. Others have been overextended by attempting to process small volumes of a broad range of products resulting in higher unit operating cost not competitive with other plants in the industry.

Studies of selected dairy production operations have shown that, by proper planning, dairy farmers with milking herds of sufficient size can

increase their income by processing their own production rather than marketing it through normal channels. This report provides layouts and cost data for dairy farmers considering the construction and operation of on-the-farm milk processing plants. A grade "A" dairy production operation with a 200-cow milking herd was selected for study and used as a basis for developing the information in this report.

The study includes a detailed description of a new on-the-farm milk processing plant built in conjunction with an existing production operation. Layouts show the arrangement of the individual plant areas and equipment and the other facilities on a building site. The estimated initial investment, annual ownership and operating cost, and potential benefits are determined for the new plant, including the minimum production required for a profitable operation.

DESCRIPTION OF THE NEW MILK PROCESSING PLANT

The new plant is essentially rectangular and contains approximately 3,250 square feet of floor-space (fig. 1). It is a one-story concrete block and wood structure with a gable roof and a 12-foot interior ceiling height. The plant, which is built on a fill, is attached to the existing milkhouse (fig. 2) at one corner to provide access between the production and processing operations. It is designed with the processing and filling room next to the milkhouse and the supporting areas adjacent to and extending to the perimeter. This arrangement allows each plant area to be easily expanded for future growth. A good flow pattern is provided, with the individual areas arranged in sequence to simplify operations and minimize costs. The entrances and exits normally used on a routine basis are on the opposite side of the plant from the holding lots and sewage disposal lagoon to aid in controlling flies and minimizing odors.

Other considerations must be complied with in the design and operation of the new plant. The floors must have smooth surfaces that are impervious to moisture and easily cleaned. The type, size, and location of floor drains and the slope of the floors must be adequate for removing the water normally discharged in a processing operation. The walls and ceilings must be properly insulated, smooth, washable, light in color, and moisture resistant. Hot and cold water out-

lets and handwashing facilities must be provided and conveniently located where needed. Safety features must be incorporated into the plant design for employee protection. The construction materials should absorb sound and minimize noise. Adequate lighting, heating, air-conditioning, ventilation, and plumbing and electrical facilities must be provided throughout the plant. Waste treatment facilities are needed to handle the effluent discharged from the plant. Qualified personnel must be consulted to determine these requirements.

Good used equipment from the many small discontinued commercial plants should be utilized to the fullest extent possible in equipping the new plant. To find the optimum sizes needed for a balanced operation to handle a given volume is often difficult. Since used equipment can normally be purchased at a substantially lower cost, acquiring optimum sizes is not essential so long as the minimum requirements are met. However, where specific equipment is not available, new equipment must be purchased to meet plant requirements.

The building site is reasonably level and well drained, with ample space for constructing and operating the plant and for future expansion (fig. 3). An approved well water supply is available at the site, with electricity provided by a public utility company. The liquefied gas for heating is pur-

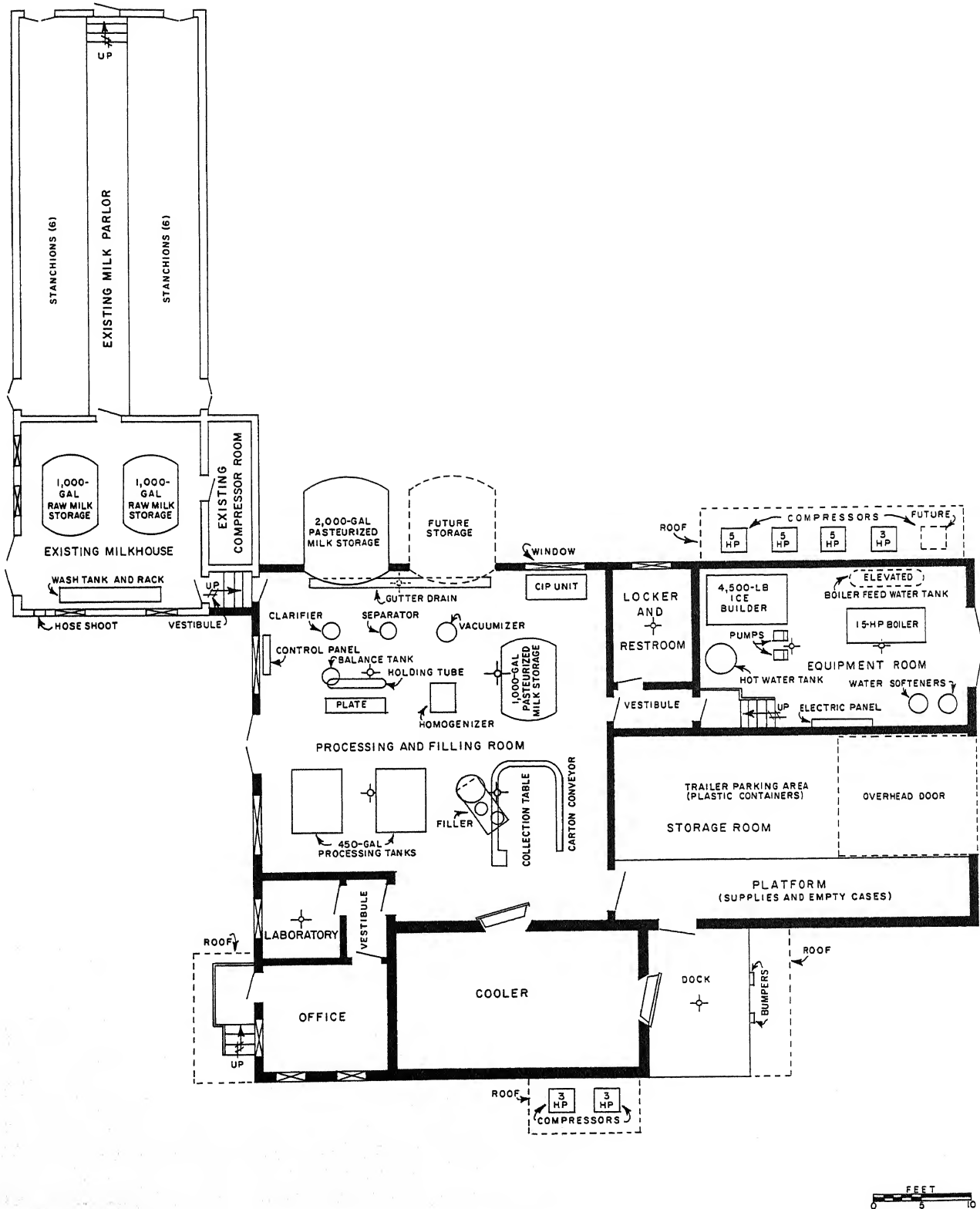


FIGURE 1. —Layout of the new milk processing plant.

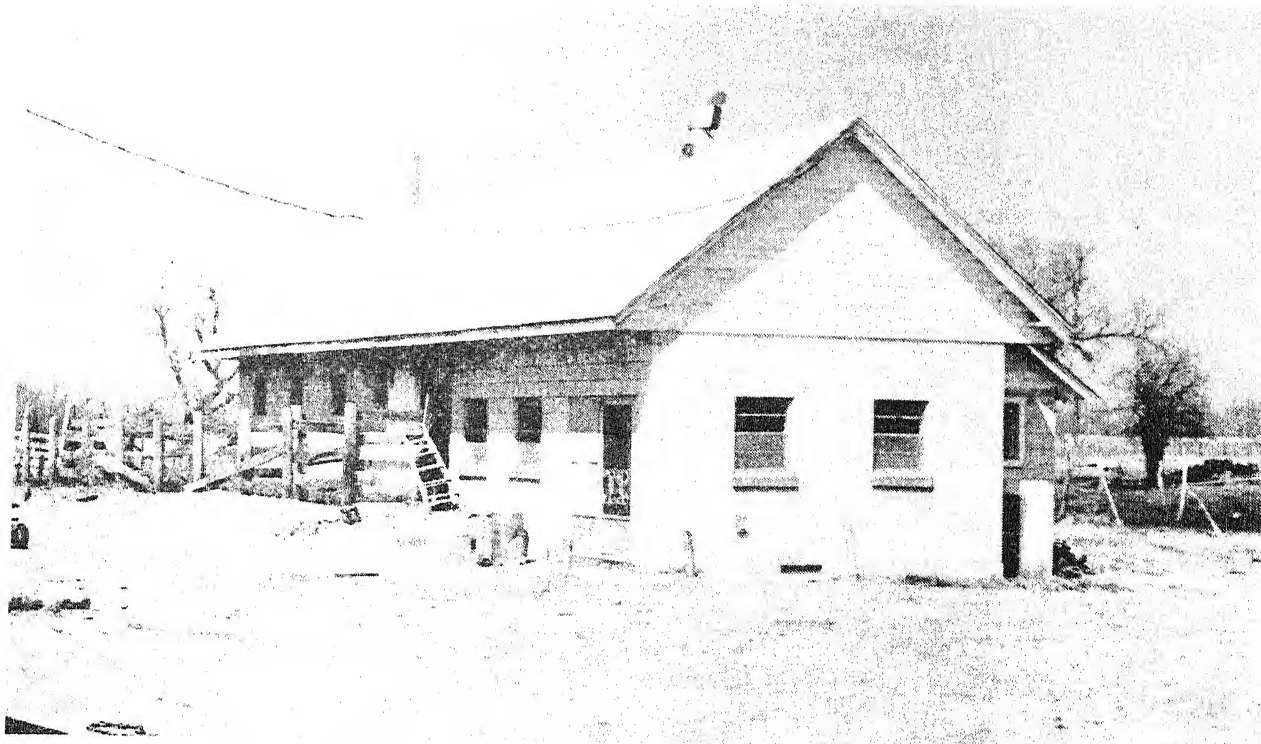


FIGURE 2. — Existing milkhouse.

PN-5941

chased from local sources and stored in tanks near the plant.

The sewage disposal lagoon is on the opposite side of the holding lots from the plant and is designed to accommodate a 300-cow milking herd.² The lagoon, 100 by 375 feet, is a total retention system, which provides approximately 125 square feet of surface per cow. It has a maximum depth of 6 feet with a 4-to-1 side slope. The waste from the holding lots feeding area and the plant flows into the lagoon. Its location takes advantage of the prevailing wind, which enhances decomposition.

Separate facilities handle the human waste from the plant restroom. An approved septic tank is installed approximately 30 feet from the restroom near the holding lots.

The new plant is designed and equipped to process and handle approximately 2,170 gallons of milk a day, 3 days a week (table 1). This volume represents the maximum daily production (8,000 lb) of a 200-cow milking herd. The total produc-

tion is processed 75 percent as homogenized whole milk and 25 percent as 2-percent skim milk, and it is packaged in gallon preformed plastic containers. Provision is also made to process approximately 500 gallons of fruit drinks 1 day a week. They are packaged in one-half gallon preformed plastic containers.

The following description and evaluation of each plant area include those changes required in the existing operation.

Prior to constructing and operating any new facilities, all Government agencies with regulations affecting the operation of dairy processing plants must be consulted to comply with specific requirements.

Usable floorspace by individual areas is as follows:

	<i>Sq ft</i>
Processing and filling room.....	1,125
Storage room.....	666
Cooler.....	336
Equipment room.....	432
Locker and restroom	¹ 128
Office and laboratory	¹ 245
Total.....	2,932

¹ Includes adjoining vestibule.

² Specifications provided by department of health officials of a southwestern State.

Existing Milkhouse

The two 450-gallon farm-style holding tanks for raw milk in the existing milkhouse are transferred to the processing and filling room and replaced by two 1,000-gallon tanks. They, along with one of the 450-gallon tanks, provide the capacity needed to store the maximum volume of raw milk holdover (2,250 gal) required with a 3-day-per-week processing schedule (table 1). Since a greater storage capacity is required only on Sunday, the use of the 450-gallon tank is more practical than installing larger storage tanks in the milkhouse. Should additional storage be required

because of poor scheduling or a temporary shut-down in the processing operations, both of the 450-gallon tanks could be used.

Processing and Filling Room

The processing and filling room adjoins the existing milkhouse at the corner next to the small compressor room. A section of the concrete block wall of the milkhouse is removed and a doorway installed for access to the plant. Steps are provided to compensate for the difference in floor levels necessary to obtain proper plant dock heights. A second doorway at the top of the steps

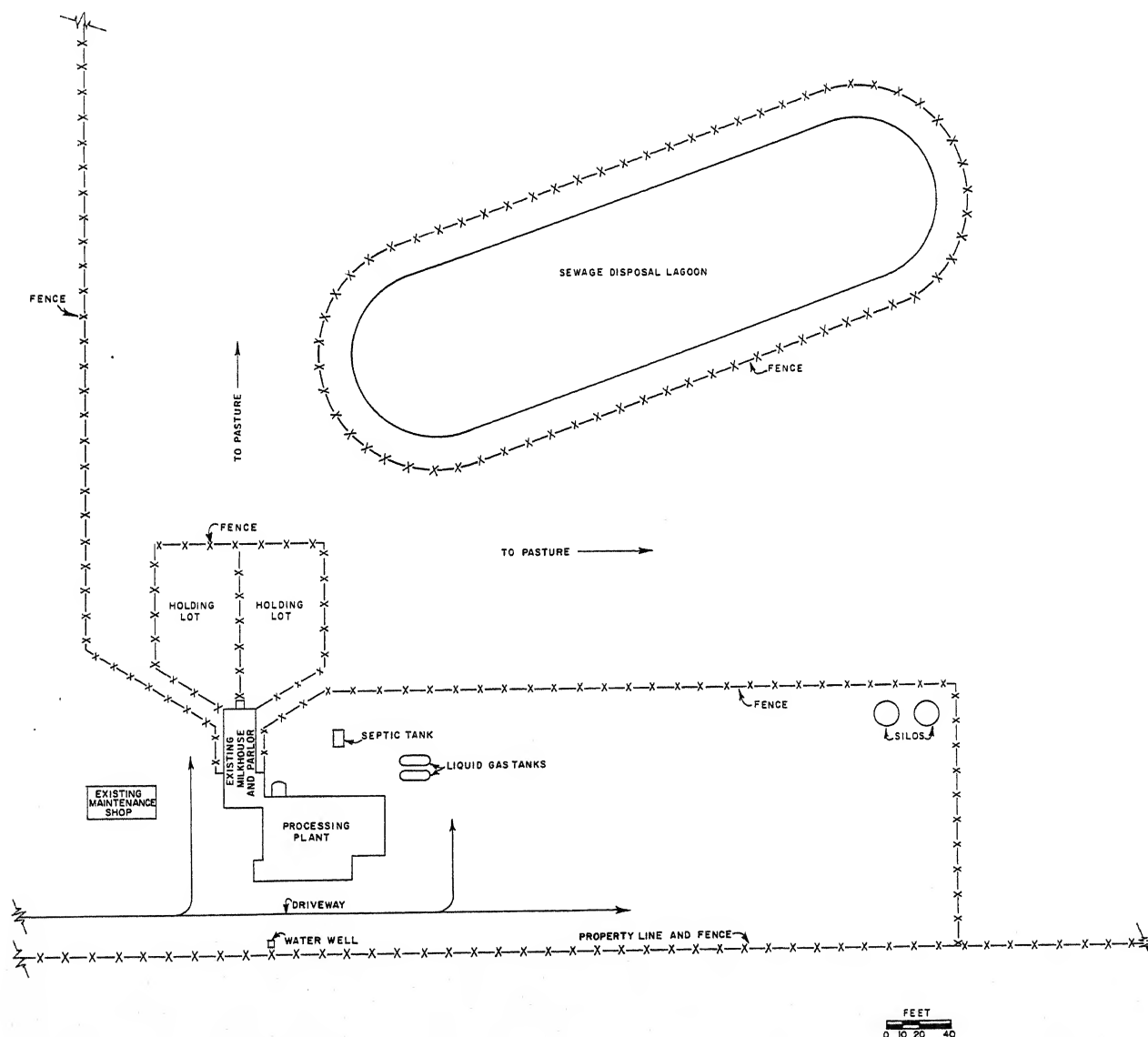


FIGURE 3. — Site plan of facilities.

TABLE 1.—*Suggested schedule for producing, processing and handling weekly volume of fluid milk products and fruit drinks*

Item	Schedule						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	Gal	Gal	Gal	Gal	Gal	Gal	Gal
Raw milk production: ¹							
A.m.	540	540	540	540	540	540	540
P.m.	390	390	390	390	390	390	390
Processed products:							
Fluid milk	2,170	0	2,170	0	2,170	0	0
Fruit drinks	0	0	0	0	500	0	0
Raw milk holdover	1,010	1,940	700	1,630	390	1,320	2,250
Products shipped:							
Fluid milk	868	868	868	1,302	1,302	1,302	0
Fruit drinks	0	0	0	0	250	250	0
Finished product holdover	2,170	1,302	2,604	1,302	2,420	868	868

¹ Based on a daily milking interval of 10 and 14 hours (5 a.m. and 3 p.m.).

creates a vestibule between the milkhouse and plant to aid in odor and fly control.

Space is available outside the plant adjacent to the processing and filling room for installing a 2,000-gallon pasteurized milk storage tank and a future tank when the need arises. The 2,000-gallon tank can store the total daily volume (1,628 gal) of homogenized whole milk. It is installed with the head extending through the wall into the room. A section of removable wall is constructed for a future tank to simplify its installation. This method of installing tanks prevents them from occupying valuable floorspace and reduces the initial construction cost.

The HTST (high temperature, short time) unit and other processing equipment are arranged in the room so that sufficient space is available for aisles and working areas and for installing larger equipment. The 1,000-gallon pasteurized milk storage tank can store the total daily volume (542 gal) of 2-percent skim milk. The two 450-gallon raw milk storage tanks transferred from the existing milkhouse are used to process the total daily volume (500 gal) of various flavors of fruit drinks. Separate tanks provide added flexibility and permit the simultaneous preparation of two different flavors of fruit drinks. The tanks are also used for storing raw cream and for emergency storage of other products. The plastic container filler and the two 450-gallon tanks are near the storage room and cooler to minimize the distance and labor required to move supplies and finished products.

The HTST unit can process 382 gallons per hour at 90-percent efficiency, the total daily volume (2,170 gal) of fluid milk products in 5 hours and 41 minutes. The batch processing of the total daily volume of fruit drinks (500 gal), which is not controlled by equipment operating time, requires approximately 1 hour on each processing day. The fruit drinks are prepared and containers filled while the HTST unit is building up an adequate supply of pasteurized milk hold for filling. The plastic container filler is designed to fill both 1- and ½-gallon containers. It can fill the 1-gallon containers of fluid milk products at 1,440 gallons per hour at 80-percent efficiency in 1 hour and 56 minutes. The ½-gallon containers of fruit drinks, which are filled at 960 gallons per hour, require an additional 32 minutes a day for a total daily filling time of 2 hours and 28 minutes. The difference between the HTST processing rate and the filling rate requires a larger volume buildup of pasteurized milk hold prior to filling and is compensated for by properly scheduling the two operations and utilizing the maximum storage capacity of the available tanks. Even though the filler has a much greater capacity than needed and is therefore poorly utilized, it does provide growth potential.

Storage Room

The storage room, 18½ feet wide by 36 feet long, is next to the processing and filling room and between the equipment room and the cooler. It consists of two areas. One is for parking a flat-

bed trailer loaded with preformed plastic containers. The other is an interior platform built at the same floor level as the processing and filling room for storing miscellaneous supplies and empty cases.

The parking area is 12 feet wide and designed so that the bed height of the trailer is the same height as the platform. Approximately 250 bundles of preformed plastic containers are hauled and stored on the trailer and used as needed. To maintain an adequate supply of containers, about 34 trips a year are made between the plant and source of supply.

The interior platform, which is 6 feet wide, not only provides storage space but also is used for moving supplies by two-wheel handtrucks from the storage room into the processing and filling room and for transferring empty cases on stack dollies from the cooler dock or storage room to the filling area. It can also be used for loading trucks with products directly off the filler without going through the cooler. Since the platform is essentially utilized for moving supplies and products, only 160 square feet of floorspace are available for storage purposes. By minimizing the inventory supply of milk powder used in processing 2-percent skim milk and the sugar and flavor bases for processing fruit drinks and by storing only a part of the empty cases, the space is adequate to meet storage requirements. However, if for sanitation reasons a separate room is required to store these ingredients, a part of the platform adjacent to the storage room overhead door could be partitioned for this purpose. Approximately 12 trips a year are made to haul the milk powder, sugar, flavor bases, and other supplies from their source to the plant.

Cooler

The cooler is a prefabricated walk-in box, 16 feet wide by 26 feet long, installed on a recessed concrete foundation so that the floor level is the same as that of the processing and filling room. Its location next to the filling area minimizes the distance and labor requirements in moving finished products from the filler into the cooler.

The maximum holdover volume of fluid milk products and fruit drinks stored in the cooler is 2,604 gallons (table 1). The cooler contains 336 square feet of interior floorspace; however, by stacking the cases on dollies five high and limiting

the width of the aisles, only 285 square feet are required to store the maximum holdover volume. Stack dollies are used not only for handling empty cases but for storing finished products and moving them to the cooler dock for loading.

A cooler dock, 10 feet wide by 15 feet long and 45 inches high, is provided for loading and unloading trucks. It is covered by a roof, which extends 4 feet beyond the edge of the dock and over the apron to protect the operations during inclement weather. Bumpers are installed on the face of the dock to protect it from vehicle damage. A steel plate is used to bridge the gap between the dock and truck to simplify the loading and unloading operations.

Approximately 668 empty cases are required on the day that both fluid milk products and fruit drinks are processed. Some are stored on the dock and in the storage room, but most are kept on the truck until needed. The cases are manually washed on the dock and placed on stack dollies prior to entering the plant. Where prolonged, extremely cold weather is a problem, enclosing the dock may be necessary to wash the cases.

The refrigeration compressors are installed on concrete slabs outside the cooler. They are protected by a roof with the sides open for proper ventilation. The evaporative condenser is on the cooler roof.

Equipment Room

The equipment room, 16 feet wide by 27 feet long, is on the outside corner of the plant next to the storage room. It is designed to house both the refrigeration and heating equipment. The equipment is arranged in the room so that sufficient space is available for its installation and operation and for aisles and working areas. The floor is at ground level and thus increases the ceiling height and headspace above the equipment to improve ventilation. Exhaust fans are installed on the outside wall near the ceiling to dissipate the heat normally generated by this type of equipment. Access to the room is through a vestibule, 4 feet wide by 8 feet long, which extends from the processing and filling room. A doorway, 8 feet wide by 10 feet high, is provided for moving equipment in or out of the room.

To reduce construction cost, the refrigeration compressors are installed on concrete slabs outside the room and protected in the same manner

as the cooler compressors. The evaporative condensers are on the roof above the compressors.

Locker and Restroom

The locker and restroom area, 8 by 11 feet, is next to the vestibule and between the processing and filling room and the equipment room. The vestibule allows access from the processing and filling room to the locker and restroom as well as to the equipment room. By having the entrance to the locker and restroom off the vestibule, direct access from the processing and filling room is avoided to comply with regulatory requirements.

Office and Laboratory

The office and laboratory area is at the front corner of the plant next to the cooler and the processing and filling room. The office is 11 by 12 feet and is used to conduct business and maintain plant records. Its entrance is protected by a roof

extending over the steps and landing, which are used to compensate for the difference in ground and plant floor height.

A laboratory, 8 feet square, is used to conduct routine standardization and quality tests. A vestibule, 4 feet wide by 8 feet long, provides access to the laboratory as well as to the office and the processing and filling room. This arrangement allows the office to be locked and still permits access to the laboratory.

Where a dairy retail store would be desirable, it could be built in the current office location. Then the office could be added next to the retail store and laboratory and still provide access to the plant by rearranging the laboratory and vestibule. The site plan described here restricts the construction of a retail store adjacent to the cooler and office because of the driveway, which is needed for access to other plant areas. However, this location for a store would be satisfactory on a nonrestricted site.

COST-BENEFIT ANALYSIS

Initial Investment Cost

Facilities

The estimated facilities cost of \$57,995 includes the construction of the plant, the water well, the sewage disposal lagoon, and a septic tank system. The estimated cost of building the new plant is \$50,695 (table 2). It is computed at an average cost per square foot of \$15.60 for the light mill construction of a concrete block and wood building. The building cost excludes the value of the land; however, it does include preparing the site and installing the sewer, water, and electrical systems in the plant.

The estimated cost of the water well is \$1,800. It includes drilling and casing the well, installing a protected pressurized water tank and pump, and tying the electrical and water lines into the plant system.

Approximately \$4,500 is required to build the sewage disposal lagoon. It includes the excavation and grading of the lagoon and the installation of the drainage lines from the milking barn, milkhouse, and plant. An estimated additional cost of \$1,000 is required to install a septic tank system for disposing of human waste from the plant restroom.

TABLE 2.—*Estimated construction cost of new plant*

Facility	Area	Average cost per square foot ¹		Total cost
		Sq ft	Dollars	
Processing and filling room.....	1,200	16.00		19,200
Storage room.....	740	10.00		7,400
Cooler (walk-in box).....	416	20.00		8,320
Equipment room.....	476	12.50		5,950
Locker and restroom.....	144	12.50		1,800
Office and laboratory.....	274	12.50		3,425
Miscellaneous (site preparation .. and sewer, water, and electrical systems)	----	----		4,600
Total or average.....	3,250	15.60		50,695

¹ Based on 1976 cost of similar facilities built in areas with comparable construction cost.

Equipment

The estimated equipment cost for the new plant is as follows:

	Dollars
Raw milk storage tanks (2), 1,000 gal each.....	*9,200
Pasteurized milk storage tank, 2,000 gal.....	*5,300
HTST processing equipment (425 gal per hour).....	**10,000
Pasteurized milk storage tank, 1,000 gal.....	**1,000
Processing tanks (2), 450 gal each.....	**1,000
CIP (clean in place) unit.....	*7,500

Plastic container filler and capper	*10,000
Ice builder, 4,500-lb capacity	**3,000
Boiler, 15 hp	**1,200
Refrigeration compressors, evaporators, etc	**2,000
Air compressor, 3 hp	*1,600
Hot water tank, 120-gal capacity	*425
Water softening equipment	*1,500
Tow truck and flatbed trailer	**4,000
Dual stack dollies, 70 @ \$30 each	*2,100
Empty cases, 1,500 @ \$3.25 each	*4,875
Handtrucks (2)	*100
Office and laboratory equipment	*500
Miscellaneous (equipment installation, etc.)	6,000
Total	71,300

*1977 manufacturers' suggested retail price, including transportation and installation where applicable.

**Cost of used equipment based on 1976 data.

The estimated equipment cost for the new plant of \$71,300 includes used equipment, which is commonly available, and new equipment, which must be purchased at manufacturers' suggested retail price plus transportation and installation. The decision to purchase either used or new equipment was made arbitrarily to illustrate the combination that normally would be available to plant operators in equipping such facilities. Approximately 66 percent of the total equipment cost is for new as compared with 34 percent for used equipment. The initial investment is substantially reduced by purchasing good used equipment; however, the annual maintenance cost could be somewhat greater.

A value of \$1,000 is established for the two used 450-gallon processing tanks for raw milk storage in the existing milkhouse. This amount is included in order to project a realistic equipment cost for those situations where a milk production operation does not presently exist.

Annual Ownership and Operating Cost

The estimated total annual ownership and operating cost in the new plant is \$126,689 (table 3). Included are all the items to be incurred in the operation and the impact each has on the total annual cost. The initial investment of \$159,068 includes not only the building and equipment but also the operating capital needed to get the business underway.

The annual cost of supplies (\$64,872) includes the plastic containers, the ingredients used in processing fruit drinks and 2-percent skim milk, various cleaning materials, and other items needed for the office, laboratory, and restroom.

TABLE 3.—*Estimated initial investment and total annual ownership and operating cost in new plant.*

Cost item	Initial investment	Annual ownership and operating cost
Facilities	\$57,995	¹ \$9,240
Equipment	71,300	² 21,248
Supplies	----	64,872
Utilities	----	³ 4,556
Production labor	----	14,500
Management labor	----	⁴ 6,240
Contingency	----	⁵ 6,033
Operating capital	⁶ 29,773	----
Total	159,068	126,689

¹ Based on 15 years' depreciation, 8 percent interest on investment, and 5 percent for taxes, insurance, maintenance, etc. Capital recovery formula used to compute cost:

$$\text{Depreciation: } \frac{\$57,995}{15} = \$3,866$$

$$\text{Average interest: } \$57,995 \frac{(0.08)}{(2)} \frac{(16)}{(15)} = \$2,474$$

$$\text{Taxes, insurance, etc.: } \$57,995 (0.05) = \$2,900$$

² Based on 5 years' depreciation, 8 percent interest on investment, and 5 percent for taxes, insurance, maintenance, etc. Computed by previous formula using 5-year depreciation scale.

³ Based on usage of existing plants of similar size and type of operation.

⁴ Represents supervisory and accounting time.

⁵ Based on 5 percent of total annual ownership and operating cost.

⁶ Includes 2-week volume of supplies plus 10 percent of total annual ownership and operating cost.

Also included is \$4,350 for transporting the supplies to the plant. The plastic containers are purchased 210 miles from the plant. Approximately 34 trips are required annually at \$120 per trip. The cost per trip includes 15 cents per mile for operating a truck, \$3.50 per hour for 12 hours for a driver, and \$15 for three meals while en route. Efforts should be made to purchase the plastic containers as close as possible to the plant to minimize this cost.

The ingredients and other supplies are purchased about 35 miles from the plant. Approximately 12 trips are required annually at \$22.50 per trip. The cost per trip includes 15 cents per mile for operating a truck, \$3.50 per hour for 2 hours for a driver, and \$5 for one meal while en route. Efforts should be made to pick up these supplies along with the plastic containers to further minimize the transportation cost.

The estimated annual production labor time to process and handle the fluid milk and fruit drinks is 4,143 man-hours (table 4). At an average wage rate of \$3.50 per hour, including fringe benefits,

TABLE 4.—*Estimated annual production labor time for processing and handling 338,520 gallons of milk products and 26,000 gallons of fruit drinks*

Operation	Days per week	Man-hours per day	Total annual man-hours
	Number	Number	Number
Processing:			
HTST (milk products)	3	6.18	964.08
Batch (fruit drinks)	1	.75	39.00
Filling:			
Milk products	3	2.33	363.48
Fruit drinks	1	.53	27.56
Storing and handling empty cases:			
Milk products	3	1.80	280.80
Fruit drinks	1	.42	21.84
Storing and handling supplies:			
Milk products	3	.39	60.84
Fruit drinks	1	.32	16.64
Cooler storage and loadout:			
Milk products	3	2.00	312.00
Fruit drinks	1	.42	21.84
General cleaning:			
Facilities	3	2.50	390.00
Equipment	3	5.08 +	792.92
Plant maintenance	3	2.00	312.00
Spare and relief	----	----	¹ 540.00
Total	----	----	4,143.00

¹ Represents a 15-percent additional man-hour allowance.

the total annual labor cost is approximately \$14,500. This represents the labor requirements of four employees generally categorized as follows: HTST and batch processor, filling operator, storing, handling, and shipping employee, and cleaning and maintenance employee.

Potential Benefits

By processing the total annual volume of 338,520 gallons of raw milk and selling it at the dock for a minimum price of \$1.12 per gallon, the annual sales are \$379,142. An additional income of approximately \$12,000 is obtained from the sale of surplus cream. The 26,000 gallons of fruit drinks sold at a minimum price of \$0.47 per one-half gallon at the dock provide an additional revenue of \$24,440, for a total annual sales of \$415,582. The \$1.12 per gallon of processed milk and \$0.47 per one-half gallon of fruit drinks are based on 1977 dock prices paid by retail foodstores in a southwestern State.

With an annual ownership and operating cost of \$126,689 and a raw milk value of \$259,168, the total annual operating cost is \$385,857. The \$259,168 represents the value of 2,912,000

pounds, the raw milk production of a 200-cow herd at a grade "A" price of \$8.90 per hundredweight.³ The total sales minus total operating cost provides a \$29,725 annual profit, of which \$22,658 is from processing the raw milk and \$7,067 from processing the fruit drinks.

The estimated total annual operating cost for processing the raw milk is \$368,484, including an annual ownership and operating cost of \$109,316 and a raw milk value of \$259,168. The total sales of \$391,142 minus the total operating cost provides an annual profit of \$22,658. This profit is obtained by processing the raw milk rather than selling it at a grade "A" milk price of \$8.90 per hundredweight, which is the best marketing alternative available. The \$22,658 profit represents a 14.2-percent return on the initial investment.

The estimated total annual operating cost for processing the fruit drinks is \$17,373, which represents the difference between the annual owner-

³ 1977 blend price paid to grade "A" milk producers in a Federal market order in a southwestern State, excluding hauling and other marketing costs.

ship and operating cost of \$109,316 for processing the raw milk and the total of \$126,689. The \$17,373 excludes the annual ownership and operating cost of the facilities, equipment, and supervisory labor since they are necessary for processing the raw milk; however, it does include the cost of supplies, utilities, production labor, and a contingency allowance. With a total annual fruit drink sales of \$24,440 and a processing cost of \$17,373, the annual profit is \$7,067.

By applying the total annual profit of \$29,725 to the initial investment for facilities and equipment of \$129,295, the amortization time including interest at 8 percent is 5.57 years.

A minimum production of 220,000 gallons annually is required to make on-the-farm processing of raw milk a profitable dairy enterprise. This determination is based on the raw-processed milk

price differential using the facilities, equipment, and operating methods described in this report. The estimated annual ownership and operating cost of the facilities and equipment is reduced by adjusting the size of the plant for processing the smaller volume and by reducing the size of some equipment and eliminating others. The other cost items, which make up the total estimated annual ownership and operating cost, are reduced according to the smaller volume processed.

The estimated total annual cost of processing 220,000 gallons of raw milk is \$253,879, which includes an annual ownership and operating cost of \$85,491 and a raw milk value of \$168,388. The annual sales of 220,000 gallons of processed milk at \$1.12 a gallon and the surplus cream are \$253,992, slightly more than the total annual operating cost.

CONCLUSIONS

By building a plant and processing the raw milk production of a 200-cow herd (338,520 gal) rather than selling it at a grade "A" milk price of \$8.90 per hundredweight and the 26,000 gallons of fruit drinks, an annual profit of \$29,725 is obtained. An important factor to consider is that the annual profit can amortize the initial investment for facilities and equipment in only 5.57 years. This short-term payback, along with other favorable indicators, makes the construction of a new plant a sound economic investment. However, before a decision is made to build, a reliable source of raw milk must be available and a stable market must

be established for the finished products. Several sales outlets should be developed for the products; however, if there is only one outlet, obtain a contractual agreement stipulating the volume and minimum price with a provision to compensate for the changing price of grade "A" raw milk.

The construction of on-the-farm dairy processing plants is important to local economies because it creates additional employment opportunities. It also provides a source of products for the small volume retail sales outlets that cannot be efficiently served by the larger processors.